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How to Collect Certain Plants.

MESSRS. ENGELMANN, BEBB, BAILEY, SCRIBNER, MORONG, HILL, RAU, ALLEN, SARGENT, MORGAN, PECK, RAVENEL, SEYMOUR, HOLWAY, HERVEY, WOLLE, FARLOW, TRELEASE, AND MISSES CUMMINGS AND BUTLER.

What is usually said about herborizing is intended to apply to the common flowering plants and ferns, and such others as readily adapt themselves to the same treatment. There are classes of plants, however, for which these methods are inadequate or not applicable, and it is to supply information in regard to these that the following matter has been brought together. It is given in the words of the authors whose names are appended, each of whom is a specialist in the subject treated, and speaks from wide experience.—EDITORS.

CACTUSES (CACTACEÆ).—At the request of the editors of the GAZETTE the following directions have been prepared by Professor Trelease from the manuscript notes of the late Dr. Engelmann, which are made available through the courtesy of his son, Dr. Geo. J. Engelmann, of St. Louis.

Living cacti bear transportation well if young or medium sized specimens are selected. The entire plant, or, if large, a joint or cutting, is thrown in the shade for a few weeks to shrivel, after which the specimens are wrapped in dry hay or moss, and loosely packed in well-ventilated boxes. Treated in this way they preserve their vitality for from six to sixteen months. Seedlings are easily raised from seeds thoroughly dried and packed *in situ*. If the fruit is large and pulpy it is sliced to facilitate the drying, and should be kept from moisture, but exposed to a free circulation of air.

Herbarium specimens are best made by removing the flowers from the plant and pressing them separately in the ordinary way, after first sectioning some of them. When not too large the fruit may be dried in the same way, otherwise it is halved and excavated before being put in press, the seed being air-dried. The entire stem if small, or characteristic joints of it is compound, may be pressed till dry, after allowing it to shrivel, or if it is too large for this, a piece is removed showing the top, the insertion of several bunches of spines and of the flowers, and some of the tubercles or ribs. Sometimes it is necessary to split and excavate these specimens, and cross-sections dried under light-pressure are desirable. If the means of transportation permit, entire plants or well-selected parts are rough-dried without pressure. These "skeletons," preserved in boxes in the herbarium, are often more instructive than the more ornamental pressed fragments. When possible, it is also desirable to make alcoholic specimens of the flower and fruit.

Cacti are at best poorly preserved for the herbarium, and should always

be accompanied by the fullest possible notes and sketches made on the spot. Aside from the usual notes of locality, habitat, date of flowering and period of fruit-ripening, others should be taken upon the following points: In the trunk note habit, presence or absence of aerial roots, form and direction of branches if compound; shape, form of articles if jointed; glabrous, granular, pubescent or mammillated surface; and form of ribs and grooves when present, both in section and profile, especially near the apex of the stem. The last features are best shown in diagrams. Leaves are present in few groups, but when they occur their duration, size, form and direction are to be noted. All cacti produce more or less woolly or prickly buds known as areolæ, on which the flowers and spines are inserted. It is important to observe whether they are immersed or prominent, and their form and usual distance apart. Young and old areolæ should be compared, and particular attention given to the character and color of their woolly or bristly covering. The very characteristic spines occur on the areolæ, and differ greatly in number, relative location, size, form, direction and color, all of which are to be observed. Diagrams aid in showing the form of the areolæ and the location and section of the spines. An important character is the stability of the spines, for in some species the areolæ increase in size, and the spines become more numerous from year to year, while in others this change does not occur, and the spines may fall with age.

Flowers usually come from areolæ on the sides of the trunk or on undifferentiated branches, but in some genera (*Melocactus*, *Pilocereus*, etc.) the sterile and flowering parts are very different. The origin of the flowers (from old, one-year-old or nascent branches) and their time of expansion (diurnal, nocturnal, or diurnal persisting through the night) should be observed, together with size, shape, color and fragrance. The form and size of the (inferior) ovary, and the shape, approximate number and character of the reduced sepals that often cover it, with the nature of the wool, hairs or spines in their axils, are all important, as are the shape, size and coating of the tube of the flower. In a longitudinal section it is to be observed whether the lower part of the tube is naked or nectariferous within or not, together with the distance from the top of the ovary to the lowest stamens, the presence or absence of a vaulted arch partly closing the tube, and the form and disposition of the stamens. Any color peculiarities of these, and the color, form and relative length of the style, and especially the stigmas, are to be noted. The shape, color, texture, taste and odor of the fruit, the presence of scales and the character of their axillary products should be observed, as also whether the flower is withering-persistent on the fruit or deciduous, and in the latter case, the form of the resulting scar (umbilicus). The occurrence of few or many seeds is also important.—[GEORGE ENGELMANN.]

WILLOWS (*SALIX*).—In collecting willows take staminate flowers when in full bloom, pistillate (preferably) a little after anthesis, and again just before the capsules are fully ripe, but not so old as to burst in drying. Tag bushes from which specimens are taken, and make note of localities. Gather leaves of both sexes late in the season; better have specimens with a few lower leaves

already turning yellow than attempt to use the succulent growths of early summer. Do not try (save in a tentative way, as an aid in collecting) to match the sexes or determine the species until after your final collections in the fall. A season's experience in this way may be profitably supplemented by making initiative collections of leaves in autumn, and gathering flowers and fruits to match the next spring.—M. S. BEBB.

CARICES OR SEDGES (CAREX).—The first requisite to the study of carices is fully mature and complete specimens. A complete specimen represents the the habit of the plant as well as the characters of the inflorescence and perigynia. Whether or not the plant is caespitose or stoloniferous should be represented by the specimen, or, if the plant is large, the fact should be recorded in accompanying notes. Some characters are apt to be obliterated or injured in the most careful collecting and pressing, and they should be mentioned in a short note on the label. Such characters are the aspects of the leaves, as to whether plane or canaliculate, and the color of the plant, as to whether glaucous, dark green, light green or yellowish green. Make the notes short. Specimens should exhibit some of the leaves which do not immediately surround the culm. The short and broad root leaves of *C. arctata* are characteristic, yet rarely represented in dried specimens. The second requisite is a small number of species correctly determined and representing several sections of the genus, with which the student can compare other species. This demand arises from the fact that the characters of many species are such that they can not be represented distinctly by words, and furthermore, it is impossible, in a genus so large and so critical, to define groups so positively that one can always be sure of their limits, or to draw up a key, either natural or artificial, which will be infallible. It is necessary, therefore, that the student should at once set up certain landmarks by the critical study of a few representative species in different groups. Half the difficulty in the study of the perplexing *Acutæ* is overcome when one secures a good knowledge of the common forms of *C. stricta*. Collect abundantly of all common species. If the student has no means of securing authentic specimens he will find it to advantage to delay his study until he has accumulated a dozen or more clear species, which he can compare with each other. When he has fixed in his mind the essential features of a representative species of each important group, his progress will be comparatively rapid and easy. Especial care should be taken not to use too much weight in pressing species like *C. Tuckermanni* and *C. monile*, which have inflated and papery perigynia. To flatten the spike by pressure is to destroy the natural shape of the perigynia. It is a good practice to cut holes in the upper sheet of drying paper to allow the spikes to project into them. I usually place a few perigynia from my impressed plant in a pocket.

Specimens which are frequently used should be glued tightly upon the sheet throughout their whole extent. I had rather have my specimens laid loosely upon firm paper, than to have them strapped on sheets in the ordinary manner. If the specimens are properly glued, and pockets are used for a few loose perigynia, the herbarium will be entirely satisfactory for purposes of

study. I do not like specimens arranged in alphabetic order, unless in genera which I am not studying. With the two volumes of the Synoptical Flora, and the occasional synopses and monographs of outlying genera, we are able to arrange species of familiar genera in systematic order, and if the synopsis has an index we need experience little difficulty in finding any specimen. A brief synopsis of American carices is forthcoming.

Tall and leafy specimens should be pressed in such a manner that the culms shall stand out distinctly from the leaves. It is a common but bungling practice with such straggling specimens to tie leaves and culms together in one confused bunch before pressing. The culms should be bent over separately from the leaves, and a bit of slitted paper inserted over the junction of the broken portions to keep them in place. Similar treatment should be given long leaves.—L. H. BAILEY, JR.

GRASSES (GRAMINEÆ).—Among phænogamous plants none are more easily dried and preserved than grasses. Good dried specimens (and there is small excuse for having anything but good specimens in this order) present all the essential characters for identification in a condition but little inferior to the fresh and living plant. Excepting *Phragmites communis* and the species of *Arundinaria*, we have no natives that may not, with a little care in doubling or folding the stems, be preserved entire—inflorescence, stem, leaves and enough of the root to show its character—and yet not exceed the bounds of the standard size herbarium paper. In an order where there is so much similitude between the species the importance of having specimens illustrative of all the characters of the plant is sufficiently evident. Among some of the groups it requires very close discrimination to find definite characters for distinguishing the species, and, unless the specimens are carefully prepared and made as complete as possible, the very characters required may be wanting. The worthlessness of “snips,” merely showing the flowers and inflorescence, is as true of grasses as of other plants, and happily collectors are becoming aware of this fact, yet a glance into almost any herbarium shows a neglect in certain particulars of a more or less serious character. The distinguishing of many species is dependent almost entirely upon the root or other underground portions of the plant. Notably is this true of the species of *Agropyrum* and some of the *Poas*, yet there are no parts more often neglected in the making of specimens. The importance of the preservation of all the leaves of the culm uninjured goes without saying, but it is not so generally understood that it is quite as important to preserve the sterile shoots—the “*innovationes*” of Hackel—in a way to show their foliage and their manner of growth. The value of the characters presented by these “*innovationes*” is sometimes greater than those exhibited by the flowering stem itself, from the fact of their being less subject to variation. Their importance in distinguishing species and varieties closely related is well illustrated in Hackel’s Monograph of the *Festucas* of Europe. It is only by a close attention to these organs that we can hope to define the many forms of *F. ovina* and allied species of the Rocky Mountain region. By a careful attention to these “*innovationes*” we may yet find a key to the multitudinous and intricate Rocky Mountain forms of the genus *Poa*.

The inflorescence of the paniculate-flowered species should be illustrated when possible by samples showing the habit just previous to and following the period of bloom. In some species the panicle is expanded only for a very short time (during the period of actual bloom), following which the branches quickly become erect or appressed. Upon the adherence of the flowering glume or palea to the grain important characters are based, and it is scarcely necessary to add that ripe seed form a part of a good herbarium specimen. Grasses may be fastened to the sheets of the herbarium either with glue or strips of gummed paper. The latter method is especially suited to the peculiar habit of grasses, and even when fastened with glue the strips should be applied to the stems and stiffer parts, or they will quickly break away from the paper in handling.—F. L. SCRIBNER.

AQUATIC PLANTS (Naiadaceæ, etc.).—The Potamogetons will serve as a type for dealing with all other aquatic plants. My plan is to collect specimens, if possible, at least twice in the year at the same locality. Two things are of great importance, *submerged leaves* in good condition and *mature fruit*. Submerged leaves are at their best when the plant is young, or a little previous to flowering. In some of the species they can not be obtained at all in anthesis, as they decay and drop off before reaching that state, and in all the species they become more or less imperfect by the time the fruit matures. Mature fruit is absolutely necessary in order to identify some of the species. For instance, *P. pectinatus* and *P. marinus* can be distinguished with certainty only by the fruit. The same is true of *P. pauciflorus* and *P. Hillii*; while in the case of *P. hybridus* and *P. Spirillus* both fruit and submerged leaves are needed. It is also well to remember that a number of the species may or may not develop floating leaves. Of the thirteen species found in North America twelve have this peculiarity. Floating leaves, however, are not a typical characteristic in this genus. Prof. Tuckerman long ago observed that "the Potamogetons are typically submersed plants, and their floating leaves become of importance in characterizing the species only when taken in connection with the submersed ones." Whether such leaves are present or not will depend upon the depth of the water and the temperature of the season; and collectors must not suppose that they have discovered a new species because the floating leaves described in the books are absent, or because they appear on forms to which they are not attributed. I should not be much surprised to find floating leaves upon abnormal forms of any of the two groups which Dr. Robbins has named "*Conformifolii*" and "*Angustifolii*."

The drying of specimens is a very simple matter. All the specimens should be kept wet until placed between driers. After lying upon the table for a few moments to clear from dripping water, they should be laid separately between thick pads of drying paper. Common newspapers or coarse wrapping paper will answer the purpose very well, if sheets enough are placed between the specimens. Only a very moderate pressure should be applied, ten or twelve pound weights laid upon a pile ten or twelve inches high being quite enough. After being subjected to this pressure for two or three hours the driers should be changed entirely, even to the two sheets next to the specimens. This is the

most important part of the process, and so I repeat, *a complete change of driers should be made within two or three hours* after the specimens are placed between them, and while the specimens are still moist. A neglect to do this in time will be very apt to cause the plants to adhere to the sheets, and produce those miserable specimens so common with hasty and slovenly collectors. After this no further change is necessary, as the specimens and papers will dry themselves thoroughly within a day or two. I prefer, however, to remove the specimens the next day into the preserving sheets, or they may be mounted at once if thought best.

In the case of the more delicate species, such as *P. Vaseyi*, *P. pusillus*, *P. hybridus*, etc. (including *Zannichellia*), the specimens should first be floated in water upon card-board in the same manner as the coarser plants. Indeed, all the finer leaved forms will furnish much handsomer specimens if pains are taken to spread the branches and leaves under water upon sheets of white paper.

Najas and *Ruppia* are to be treated like the coarser species of *Potamogeton*. The two marine genera, *Zostera* and *Phyllospadix*, are best collected when in flower and fruit. Some of the specimens should be prepared with the spadix drawn partly out of the spathe so as to show the inflorescence distinctly.

The above directions are applicable to all other delicate aquatics, such as *Isoetes*, *Schollera* and *Callitriche*, and more or less to *Elatine*, *Utricularia*, etc.
—THOMAS MORONG.

To get aquatic plants from the water (root and all, if necessary, for lower leaves are often required, as well as underground stems), I have a hook, or blade, made something like a "bush-hook," used by farmers to cut off small shrubs when clearing land. Any blacksmith can make one, and the cost is but a few cents. It is about eight inches long, with one cutting edge. The eye is about $\frac{3}{4}$ inch in diameter, so as to receive a handle stiff enough for work. This blade is carried in the tin collecting box to the place of work, with a gimlet, two or three screws, and a small screw-driver, such as go with sewing machines. With a pocket knife a stick six or eight feet long is cut, inserted in the eye, which is drilled on one side to receive a screw. If the wood is hard, a hole made by the gimlet enables the screw to be forced in, and one is ready for work, to reach out and haul in specimens, or to dig in the ground. When done for the day, the screw is withdrawn and the handle thrown away.—E. J. HILL.

MOSESSES (MUSCI).—Mosses can be put into envelopes, or each specimen folded up separately in paper, and carried in a plant portfolio or other suitable receptacle. Where it is an object to preserve the spores for microscopical examination, these should at once be wrapped in waxed paper. The specimens should be removed from the envelopes or wrappers, in which they were collected and pressed, in the same manner as phanerogams. Aquatic species, like *Fontinalis*, *Sphagna*, etc., may be spread out on the floor of a shady attic until freed of their superfluous moisture to some extent, then transferred to driers.

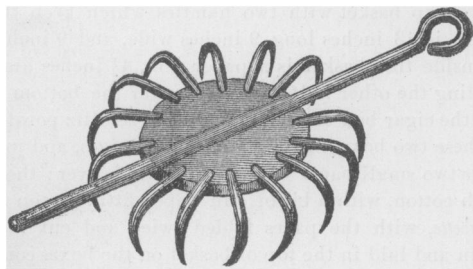
The following are notes from the late Mr. C. F. Austin in regard to the collection of mosses: "Mosses should be collected as soon as, or a little before, the capsule matures, *while the operculum is still present*. Some species seldom or never fruit with us; these should not be neglected. Hepaticæ in general are

best collected late in the fall, during the winter, or in early spring. The *Jungermannia* about the time, or a little before, they send up their fruit-stalk. All are best collected before they shed their spores."—EUGENE A. RAU.

I began by using a portfolio, but soon came to the conclusion that it took too much of the field time to prepare each specimen for pressing, and often they were not in a proper condition as regards moisture, being either too dry or too moist. A vasculum is too heavy, especially for mountain excursions. So I made an inexpensive knapsack which I have found very serviceable. It is made of carriage cloth, with a flap which buttons in front. To the back are attached loops, so that it can be suspended from the shoulders by a strap. Plenty of newspaper should be taken and each species wrapped separately. This bag when packed full will not weigh much more than the ordinary vasculum. Do not break the specimens into too small fragments.—CLARA E. CUMMINGS.

CHARAS OR STONEWORTS (CHARACEÆ).—The Characeæ, growing wholly under water, are generally overlooked by collectors. Some species grow in quite shallow water (if protected from waves) and may be reached easily by the hand from a boat, or by wading. Others grow in water from ten to twenty feet deep, and can only be obtained by dredging.

For this purpose a dredge made as follows is recommended: An iron rod $\frac{3}{16}$ of an inch in diameter and about 12 inches long, bent to form a small ring at one end, passes through and carries, below its center, a disk of lead about



DREDGE FOR CHARACEÆ.

3 inches in diameter. This disk holds embedded in it 12 to 14 iron hooks all bent toward the same side. The hooks project about an inch from the leaden disk and curve inward about an inch. The iron rod projects about three inches beyond the leaden disk, so that the end of the rod strikes the bottom

first. The lead should be heavier on the side towards the hooks, so that the dredge will fall with the hooks downward.

This dredge was recommended to me by Prof. Nordstedt and may be made much smaller if desired. It will bring up immense quantities of material in good condition.

The plants should be gathered when in fruit and laid out regularly upon paper and dried. The more delicate species must be floated out like algæ and protected by coarse cloth to prevent adhesion to both upper and lower papers, as they are apt to be infested by glutinous algæ. Most specimens are in condition in August and September, but a few are in fruit in the spring.

The forms that are covered by calcareous deposits, and which become very brittle, must be kept from breaking, either by glueing to stiff paper, or by packing in bundles protected by stiff boards.—T. F. ALLEN.

LICHENS.—In collecting lichens I find it a great convenience to have along with me some small paper bags such as grocers use. They take up very little room until wanted, and lichens put into them may be prevented from rattling around and breaking to pieces, as many of them will do if merely thrown into a box. Specimens to be preserved are either (1) those for the herbarium, or (2) those, such as rock specimens, which can not be kept on sheets. The latter I keep in trays in a cabinet. The former I keep either in paper pockets, attached to the herbarium sheets, or else they are glued to suitable sizes of rather stiff paper and these are attached to the sheets by tiny ribbon pins, a pin to each upper corner. Specimens in pockets may be more easily handled and so studied more satisfactorily. Specimens glued on paper are more readily seen when one is running over a cover full of sheets, and thus rapid reference is facilitated. When I have specimens enough of a given collection I try to have some glued and some in a pocket. The form of a pocket which experience has shown me is the easiest and quickest to make, and the easiest to handle, is one which I suppose is familiar to most botanists. It is made as follows: Fold a piece of paper so that the under part shall project about $\frac{3}{4}$ of an inch beyond the upper; fold the projecting part over the other, making the top of the pocket. Turn the pocket over and fold back the right and left edges for about $\frac{3}{4}$ of an inch. The pocket is now finished and is to be attached to the sheet by a small spot of glue on the center of the back. It is an easy matter to fold several pockets at once.—F. LEROY SARGENT.

FLESHY FUNGI (HYMENOMYCETES, ETC.).—I gather fungi of all sorts in a basket. This is a common cheap basket with two handles which keep the lid down; it costs 25 cents. It is 13 inches long, 9 inches wide, and 9 inches high to the top of the lid. Inside this basket is a paper box, $4\frac{1}{2}$ inches high and filling half the space; filling the other half of the space on the bottom is a common cigar box. Inside the cigar box at each end are two seidlitz powder boxes (paper) and between these two boxes standing on their edges, and just filling the remaining space are two small paper boxes with sliding cover; these two small boxes are filled with cotton, with a bit of stiff paper fitting upon it. A copy of the *Commercial-Gazette*, with the pages folded twice and cut into sheets; then these folded again and laid in the top of basket on the boxes completes the outfit for taking care of every sort of specimen that can be gathered.

The tools are (1) a very strong steel kitchen knife, handle and blade all welded into one; it costs 10 cents, and is stuck in the slots inside the basket; (2) a first class pocket knife, with the blades, large and small, kept very sharp, (3) a good lens—I use a Coddington.

The larger and firmer Agarics and Boleti will go in the larger box, the smaller or more tender ones, such as Coprini, in the smaller boxes. The two sliding boxes filled with cotton are intended primarily for Myxomycetes; but they are equally useful for Mucedines, Mucorini, small Pezizas, that is, anything small and delicate. The sheets of paper can be used to wrap up sets of leathery and woody specimens such as Polypori, or sets of leafy fungi can be placed inside their folds and laid out flat in the bottom of the basket. In the case of very large specimens, such as *Agaricus illudens* for example, the boxes can be taken out and the whole interior of the basket used. I sometimes come

in with the small boxes in my pockets, the larger ones in one hand and the basket in the other, with the folded papers on the top of the lid between the handles.

The strong knife is used for digging, or for prying off pieces of wood, bark, etc. The sharp knife shaves off thin slices bearing Myxomycetes, molds, Pyrenomycetes, etc. I seldom go after specimens of fungi in the afternoon, but usually return with my specimens at noon. They are immediately spread out on the floor on newspapers to dry and to be examined; the caps of Agarics and Boleti are cut off and placed on white paper to catch the spores, a glass slide being slipped under also. After dinner the most perishable specimens, Coprini for example, are immediately figured; those that will keep over night can be figured next day. The figures are made the easiest, quickest and best with oil on prepared paper. Our sheets are 7 by 10 inches. We sometimes use water colors for slender branched Clavarias and for small Pezizas. There need be no attempt at picture making in these figures; the outlines must be brought out exactly in true perspective and the colors and gloss must be perfect. In the afternoon, too, the fleshy perishable fungi should be carefully examined and determined if possible. Some will probably get away every time before they can be satisfactorily made out and figured. Such as appear to be new species should be carefully described, using the nearest related species as a model, carefully stating the points of difference and indicating its proper place in the genus. New species will do to rest in the stocks a long time; and you will find after a while that three-fourths of them have been described, and then you can publish the remaining fourth. My note book has "n. sp." in it four or five years old, and I am not the least afraid somebody will find them and publish before me.

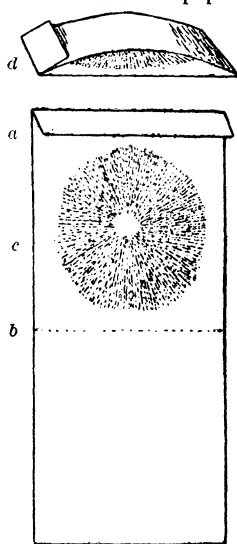
I dry my specimens around the stove if there is a fire, as in autumn, or in a warm dry attic in summer. The air should not be too hot, as in an oven; warm dry air from a furnace is excellent, and the specimens can be placed on the register. After being thoroughly dried they can be dampened by being rolled up in a piece of wet newspaper for a short time; then spread out and subjected to gentle pressure to fit them for the herbarium sheets. Dried Agarics, however, are not very satisfactory specimens without their figures; they seldom preserve any microscopic characters, like Pezizas. Dried puff-balls, however, are extremely valuable specimens; they should be stored away in boxes and kept in their natural shape. I store up Polypori in the same way.—A. P. MORGAN.

Of the fleshy fungi, the living plant is in the best condition for study and identification, properly dried specimens stand next, and moderately pressed specimens are third in value. Alcoholic specimens, badly pressed specimens, and sections or fragments dried in the plant press, are practically worthless for these purposes.

Select the best specimens and reject old, worm-eaten, water-soaked, badly deformed or otherwise imperfect examples. Collect freely of each species whenever it is possible, for some specimens may be spoiled in drying or in analyzing, some may be needed for exchanges, and at least four should be reserved for the herbarium. If the pileus is hygrophanous, viscid, or striatulate, these characters should especially be noted. There is also some advantage in ascertaining

at once the internal character of the stem and the color of the flesh. This may be done by making a vertical section through the center of the pileus and its stem.

In the Agarici it is of the first importance to ascertain the color of the spores. The numerous species have been arranged by Fries and other authors in series depending upon this character, and, when it has been ascertained, the first step has been taken toward the proper location and identification of the species. The color of the lamellæ in mature specimens often corresponds very nearly to the color of the spores, but there are many exceptions. Sometimes specimens will be found to have dropped their spores on subjacent objects in such quantity that their color can be readily ascertained at the time of collecting. Microscopic examination may approximately reveal it, but in some respects the old method of receiving the spores on paper, as they drop from the lamellæ, is the most accurate and most satisfactory method of ascertaining their color. It is then presented to the naked eye in a manner in which it may be preserved for future use. Rather stiff white paper should be cut in slips a little wider than the diameter of the pileus whose spores are to be caught. The length should be a little more than twice their breadth. Make a transverse fold about half an inch broad across one end. Select a fresh, well-developed plant, and cut the pileus from the stem. Place the former in its natural position, lamellæ downwards on the paper between the folded margin and the middle of the slip.



Paper with spores on it. *a*, The narrow transverse fold at the end of the paper. *b*, Dotted line through which the second fold is to be made. *c*, Space on which the spores fall. *d*, Side view of the paper as finally folded.

This leaves the other half of the paper free, and after the spores have been dropped it is to be doubled over and its free end thrust under the transverse fold already made. It then covers and protects the spores. This covering fold should be a little longer than the part holding the spores beneath it, that it may form a low arch over them and not press upon or disturb them. (See annexed diagrams.) If the spores prove to be white, or it is suspected at first that they are white, black paper may be used, as white spores will be more conspicuous on it. Generally in a few hours or a single night a stratum of spores thick enough to show the color satisfactorily will be obtained. If the pileus is very small or thin a goblet or other suitable vessel may be inverted over it, that the moisture may be retained and the pileus not shrivel before it has dropped its spores. The paper bearing the spores should be properly labeled and kept in a tin box with a close-fitting cover. It should contain a small open bottle of chloroform, otherwise insects will be likely to find and devour the spores.

After the specimens have been dried they may be dampened by placing them in front of an open window during a rainy day or dewy night, or kept for a time beneath several layers of damp paper. Water should not be sprinkled upon them, but very thick,

firm specimens are sometimes softened by steaming. They are then subjected to light pressure in the plant press.

The hard bulky and corky species of Polyporus, Trametes, etc., need no preparation except poisoning. They should be kept on shelves or in drawers. In public herbaria where space is available they should be placed in trays and kept under glass in table cases. If it is desired to have them represented in their proper place in the herbarium, make vertical sections through the central part of the pileus. These may be from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch thick and can easily be attached to the sheets.

It is very important that the specimens should be poisoned. It is best to apply the poison as soon as convenient after the specimens are dried. Various preparations have been tried, but I find none better than the ordinary mixture of corrosive sublimate and alcohol. A paste made of raw rubber soaked in bisulphuret of carbon is the most satisfactory for mounting specimens of anything I have tried. Fragile or delicate specimens may be protected by attaching a thin piece of cork to the sheet by the side of the specimens.—CHAS. H. PECK.

The specimens should be put in the sun, gills upward. Unless very large one day's bright sun will dry them thoroughly. The large thick Boleti will require two days or more. When thoroughly dessicated, they are left out in the night air (under cover from rain), which gives them sufficient flexibility to be pressed into shape. The small group of Phalloids is perhaps the most difficult of all the Fungi to preserve well. They, too, must be exposed to the sun, or dry air, until perfectly dry, and the repulsive fetid odor destroyed. But they shrink so much in drying, and are so distorted from their fresh state, as to be very unsatisfactory. Full notes should be taken from the fresh specimens of all the chief characters, and if one can overcome the nauseous fetid odor long enough, a drawing should be made.—H. W. RAVENEL.

A rapid and very satisfactory way of drying fleshy fungi is to use a chemist's drying oven heated with steam or hot water. With suitable regulation of the temperature, which a little experience will make easy, the best and most uniform results may be obtained, and without the usual tediousness and uncertainty. By this method the most deliquescent sorts can be preserved as easily as any other. When dry the specimens can be placed at once in a covered jar or pail with a wet sponge, and in an hour or two will be limp enough to be put between driers, and the next morning be ready for poisoning and mounting.

PARASITIC FUNGI (UREDINEÆ, ETC.).—Experience and observation teach that a beginner in parasitic fungi is almost certain to be deceived by the work of insects, mites or related animals. To distinguish between these in some cases is impossible without microscopic examination; but eventually one learns to distinguish in most cases by a glance. No general rule can be given and a description of special cases would be long. A collector must train himself to see and to distinguish. Probably one can succeed best by beginning with some particular group of fungi. Some knowledge of the plants to be looked for is a

great help. Begin with the group in which you are most interested, say Uredineæ. Look over the published lists and descriptions to which you have access; get an idea of how many species there are, what they grow on, what time of year they occur. Notice particularly some likely to appear soon, and look at specimens of them if possible. These will be impressed upon your mind and when you go out you will look sharply for any unusual appearance of that host. You will find a few species that are well known and these will be a nucleus. They are marked by certain appearances of the host. Similar appearances on other plants will be more easily seen and each new success will bring increased interest and increased ability. If you are not interested in other groups and know nothing about them, you will scarcely see any of their species. You may, however, look for all kinds, but your greatest success will be in the groups which you know best and in which you are most interested. As knowledge and experience increases, new groups will be brought in, but the field is so large that it is bewildering to attempt all kinds at first.—A. B. SEYMOUR.

The equipment necessary is a tin box, 8 by 12 inches, and 6 inches deep, with a tight fitting lid, a small portfolio (or an old book), and a pocket lens. Nearly all specimens will keep well for a day in the box, but the portfolio is useful in keeping leaves which cure quickly, and for the more careful preservation of rarities.

The last of May or the first of June, depending upon the season, I go to a favorite valley about half a mile wide, with a creek running through it, well shaded by large trees. On the south side are low hills, covered with young trees, with occasional springs running down and forming small bogs in the valley. On the north are higher rocky hills, with here and there a deep gully worn by the waters from the land above, thickly overgrown by small shrubs.

Walking along the hills on the south my attention is attracted by some leaves of *Anemone nemorosa*, and *A. acutiloba*, which are smaller than their neighbors, and borne on longer petioles. An examination of the under surface of the former reveals on some the beautiful cups of *Æcidium punctatum*, and on others the dark sori of *Puccinia fusca*; the thickened leaves of the latter are covered with *Æcidium hepaticatum*. A further search among the leaves of *A. nemorosa* is rewarded by the purple dots of *Synchytrium Anemones*, the frosting of *Peronospora pygmea*, the black pustules of *Urocystis Anemones*, and the small cups of *Æcidium Ranunculacearum*. A good contribution for the little may-flower!

Going towards the valley, I find a luxuriant growth of *Podophyllum peltatum*, infested with its bright orange cluster-cup, *Æcidium Podophylli*, and a little later in the season, a similar locality furnishes *Puccinia Podophylli*. At the edge of the valley, the lovely *Claytonia Virginica* is blooming, and a short search adds to my treasures *Puccinia Mariæ-Wilsoni* and its *æcidium*. Walking down the valley, with a sharp look at every plant, I come to a mass of the delicate *Isopyrum biternatum* and soon find *Æcidium Ranunculacearum*. Then *Arisæma triphyllum* contributes *Æcidium Caladii*, and a subsequent visit gives me the uredo and teleutospores of *Uromyces Caladii*. A plant of *Ranunculus abortivus*, a little taller and more slender than it should be, shows the

work of *Æcidium Ranunculi*. *Viola pubescens* gives *Æcidium Violæ*, and later *Puccinia Violæ*. Tramping on, *Mertensia Virginica* stops me by the yellowish spots on the leaves; I examine with my lens, and doubt its being a fungus, but throw a leaf into my box. A microscopical examination at home shows it to be *Entyloma canescens*, new to the United States—and then I wish I had been less skeptical.

Crossing the valley, I add *Puccinia Cryptotænæ* on *C. Canadensis*, and climbing up a deep gully, I am delighted with the discovery of a large *Lonicera Sullivantii*, every leaf spotted by *Æcidium Periclymeni*. Coming out, I find small shrubs of *Zanthoxylum Americanum*, leaves and petioles bright with *Æcidium Zanthoxyli*. A visit to the bogs adds *Peronospora obducens* on cotyledons of *Impatiens*, and later in the season, *Puccinia spæta* on *Mitella diphylla*. During the season this valley yields several species of *Peronospora*, *Entyloma*, *Septoria*, *Cercospora*, and many of the *Erysiphei*.

Few localities are as rich in species as this, but something can be found almost anywhere. I have found heavy woods the most barren. River bottoms, low meadows, deep ravines, hills with springs running down them, and especially recent clearings in the woods, are good collecting grounds. Sloughs and swamps give the species on *Sedges*, *Iris*, *Acorus*, etc., and the grasses of dry rocky hills are usually covered with *Puccinias*.

Reaching home with my box packed full, I take my pile of driers, lay the leaves carefully between sheets of paper, a drier between each, and when all are arranged, place a board on top, with a small weight, just enough to keep the leaves well flattened; too much will injure *Æcidia*. It is necessary to change the driers *often* to make good specimens. When dry I poison them with corrosive sublimate and carbolic acid (*BOT. GAZETTE*, vol. 1, p. 27), place in wrappers of good white paper, and glue the wrapper to the herbarium.—E. W. D. HOLWAY.

MARINE ALGÆ.—The flora of the sea is distributed through a belt nearly touching the high tide mark on the one side and extending to a depth of several fathoms on the other. Most of the plants, however, grow between tide marks or at a little distance below. It is evident that these can be collected without difficulty at low tide, taken from the rocks by the hand or with the aid of some simple tool. For getting plants which grow just below tide, a pair of rubber wading boots, which will allow one to go into the water up to the knee or above, is very convenient. And for capturing plants which come floating up on the waves or are attached to the rocks just out of reach of the hand, the writer has found very handy an instrument made in the following way: At a kitchen furnishing shop buy a wire spoon. It is used I think for taking various things out of boiling water, in the process of cooking. This can be tied to a stick of any desired length. I find nothing more convenient than the two lower joints of a common fishing rod. These may be quickly taken apart or put together to make the handle of our spoon shorter or longer.

Those plants growing in deep water may be sought for either by the use of a grappling hook attached to a line and thrown down among the plants to pull them up and bring them to the surface, or by hunting among the

rejectamenta upon the beaches, or watching for them in the waves of the incoming tides.

All but the coarser forms, like the Fuci and Laminariæ, are mounted by "floating out" on paper and dried in a press. The paper best adapted to the purpose is a good quality and weight of demy or some lighter kinds of drawing paper. It should be cut in three or four regular sizes by dividing the sheets into quarters, eighths, sixteenths, etc.

A simple and handy apparatus for floating out the plants consists of a shallow tin dish, which may be had at any tin shop, 8 by 11 inches, and 1 inch deep, and a plate of zinc $12\frac{1}{2}$ by $6\frac{1}{2}$ inches, perforated by six rows of half-inch holes, an inch and a half apart in the rows, the perforations extending over only about 10 inches of the plate. Fill the dish three-quarters full of sea water, wet the paper and lay it on the zinc, thrust both into the water and lay on the plant. Spread it out carefully, lift up the end of the zinc which will draw the paper and plant out of the water. Let it drain a moment and then remove to the press. Lay the paper, plant up, on a sheet of drying paper. Spread a piece of old cotton over the plant, and over this put a sheet of drying paper. Another floated out plant, cotton, drying-paper, and so on. Put in press for 24 hours. Change the cloths and drying paper and put in press, under more pressure, for 24 hours longer. Nearly all of them will be quite dry by this time. If not, change again, and so on till they are dry. Such plants as do not adhere to the paper by their own substance may be fastened to the sheets with strips of gummed paper. The Laminariæ and Fuci, and such like coarse forms, should be partly dried before putting in press. It is well also to wash them in fresh water, and such as will bear it to soak them out in fresh water, to get as much of the salt as possible out of them. These plants are arranged in the herbarium in the usual way.—A. B. HERVEY.

FRESH-WATER ALGÆ.—They should be looked for in ponds, quiet or sluggish waters, in swampy grounds with pits which retain water during the summer months, mountain ravines with cascades, moist, shaded and dripping rocks, and sheltered angles of lakes and rivers. The equipments may be simple, unless for a long and thorough search. A few wide-mouthed vials and some small sheets of brown paper, five or six inches square, will be sufficient. Filamentous algæ will drain quickly, are then placed upon a sheet of paper which is folded, and in this way may be kept for days in good condition. Water likely to contain desmids and other small floating plants is to be placed in the vials. If a larger vessel is at hand dip the material into it, allow it to settle, drain off the water and bottle the thicker substance. The bottled material will become fetid after several days, but it may be preserved for months and even years by the addition of a few drops of carbolic acid, just enough to make its presence perceptible. It may be well to bear in mind that the freshest and brightest green forms are not usually the most desirable. Among the older and more unsightly more mature and fruiting specimens may be found.—FRANCIS WOLLE.

DESMIDS (DESMIDIEÆ).—Unlike their near relatives, the diatoms, which may be found in greater or less quantities in all waters, desmids are select and

elusive, the result of long tramps, the reward of perseverance, long-suffering, and other kindred virtues. A collector of desmids needs to be provided with a large stock of patience, considerable endurance, and some courage, a pair of rubber boots, and vials *ad libitum*.

Except the most common forms of Closteria and Cosmaria, they particularly affect clear pure water. For instance, a summer's search in Dakota was fruitless on account of the alkaline water. Strong currents are also unfavorable to their deposition. I have made my best "finds" in small pools or ponds, fed by springs, or connected with larger lakes by underground channels, such water being pure and undisturbed by currents or waves.

Desmids sometimes form a delicate green film on the banks or bottom of a pool, in which case they can be gently urged by the help of a spoon into a wide-necked bottle; but more commonly they can be found clinging to the stems and leaves of aquatic plants, such as Vallisneria, Anacharis, Myriophyllum, etc. When I find sphagnum under water I am jubilant, for it has never failed with me to produce desmids in abundance. They can be stripped from the leaves by the hand, or, better still, the moss can be gathered, being careful to dislodge as little mud as possible, and washed thoroughly in water. When the sediment has settled pour off the superfluous water. Your microscope may show the remainder to be a rich harvest of such inexpressibly rare and beautiful forms as to make one forget all fatigue and vexation.—ELOISE BUTLER.

NOSTOC GROUP (PHYCOCHROMACEÆ).—Thin gelatinous species, which form expansions on the ground or on rocks, are prepared by removing them with small portions of the substance to which they are attached and allowing them to dry under slight pressure between plates of glass or other hard substances to which they will not adhere. The smaller and more delicate aquatic species should be floated out on pieces of mica or glass and dried in the air, but not exposed to strong sunlight. They may also be floated out on paper like larger algæ, but, before pressing, they should be allowed to dry a few hours in the air. In the press they should be covered with thin unglazed cloth as in the case of algæ. Species like Oscillariæ, which have a vibratory motion, may be placed in a large drop of water on a moistened paper, and left over night. In the morning the threads will have separated from one another so that the specimen has expanded into a circular shape and the threads have arranged themselves radially. Large nostocs of an irregular shape may be pressed like larger algæ, but they sometimes are a good while in drying. Prepared in this way they are not unfrequently considerably distorted, and it is well to keep a few specimens rough dried for study. On remoistening they swell to nearly their original proportions. Specimens preserved in alcohol or glycerine are of little value.—W. G. FARLOW.

SLIME MOLDS (MYXOMYCETES).—The excellent account of the methods of collecting and preserving this class of plants given by Dr. Geo. A. Rex in this journal a year ago makes it superfluous to go over the ground again. We, however, desire to call attention to a superior manner of preserving material

for the herbarium and ready examination under the microscope, which Dr Rex now uses, and which the writer had the pleasure of seeing upon a recent visit. Instead of using small boxes, which are somewhat awkward for plac-



THE PIERCE CELL.

ing under the microscope, the specimens are mounted in a metal cell, which is firmly fastened to an ordinary glass slide, and provided with a close-fitting metal cap. The bottom of the cell is covered with dark green wax, on which the material is mounted so as to give both vertical and lateral views. The cap is so nicely made as to exclude dust and insects and yet be readily removed for examination. The slides can be placed in a suitable shallow box and slid into place in the herbarium, as explained elsewhere in this number. This cell was devised by Mr. J. Pierce, of Providence, R. I. We are indebted to J. W. Queen & Co. for the use of the cut illustrating it.

BACTERIA (SCHIZOMYCETES).—Bacteria are commonly preserved for the herbarium by drying some of the zooglea, or drops of fluid swarming with them, on bits of mica, and placing these in small envelopes gummed or pinned to the herbarium sheet. They are apt, however, to flake away from the mica after a time and may ultimately be entirely lost, as the dried film is exceedingly friable. To obviate this difficulty the specimen may be incorporated with a drop of some mucilaginous substance, like *Althæa* extract, freshly prepared and filtered. It has been asserted that this preserves their vitality, so that they may be used for starting new cultures after a long duration in the herbarium.

No specimens are so satisfactory for study as mounted slides, prepared by smearing a *very thin* film of distilled water containing the bacteria over the middle of a slide, drying it rapidly (but without heating too much) over an alcohol lamp, staining with a drop of freshly-filtered fuchsine, methyl violet, or some other aniline dye, which is removed at one side by a bit of blotting paper, after which the slide is dried as before, a small drop of fluid balsam or benzole-balsam added, and a cover-glass at once applied.

Few persons are aware how easy it is to obtain a considerable number of pigment species, several of which I have described in my "Observations on Zoogloæ, etc.," all that is necessary being to rub pieces of boiled potato about on the floor, in sinks, etc., where dust collects, and set them away for a few days, covered by inverted tumblers to keep them moist.

No slide or herbarium specimen is worth much unless accompanied by full notes on the nature and color of the zoogloæ it comes from, or the effects it produces; and a slide or specimen which contains more than one species is an abomination which had best be destroyed as soon as made, before it has opportunity to do harm.—WILLIAM TRELEASE.

YEAST (SACCHAROMYCETES).—The yeasts should be spread out in a thin layer on pieces of mica or glass. The pieces can be moistened in spots and used as microscopic slides and answer well enough for the comparisons of different forms.—W. G. FARLOW.